

WHAT IS CLAIMED IS:

- 1                    1.        A method of fabricating a lead frame for a semiconductor device  
2 package, the method comprising:  
3                    providing a first metal layer;  
4                    patterning a mask over the first metal layer to reveal exposed regions;  
5                    electroplating a metal over the exposed regions;  
6                    removing the mask; and  
7                    encapsulating at least a portion of the first metal layer and the electroplated  
8 metal within a dielectric material.
- 1                    2.        The method of claim 1 wherein providing the first metal layer  
2 comprises providing a copper roll, and electroplating the metal comprises electroplating  
3 additional copper.
- 1                    3.        The method of claim 2 further comprising creating a pattern of  
2 holes in the first metal layer to define a lead frame comprising a diepad portion separated  
3 from a pin portion.
- 1                    4.        The method of claim 3 wherein creating the pattern of holes  
2 comprises etching completely through the first metal layer.
- 1                    5.        The method of claim 3 wherein creating the pattern of holes  
2 comprises stamping completely through the first metal layer.
- 1                    6.        The method of claim 1 wherein the electroplating forms a QFN  
2 package pin portion exposed following encapsulation.
- 1                    7.        The method of claim 6 wherein the electroplating forms a diepad  
2 portion exposed following encapsulation..
- 1                    8.        The method of claim 1 wherein electroplating the metal forms a  
2 raised feature on an upper side of a diepad of a power-type package selected from the  
3 group consisting of TO-247, TO-220, DPAK, D2PAK, SO-x, and power BGA, for  
4 ensuring even spreading of adhesive and resulting uniform attitude of a die placed attached  
5 to the upper surface.

1                    9.        A method of fabricating a lead frame for a semiconductor device  
2 package, the method comprising:  
3                    providing a first layer;  
4                    patterning a first mask over the first layer to reveal first exposed regions;  
5                    electroplating a first metal over the first layer in the first exposed regions;  
6                    patterning a second mask over the first mask to reveal second exposed  
7 regions;  
8                    electroplating a second metal over the first mask in the second exposed  
9 regions;  
10                  removing the first and second masks; and  
11                  encapsulating at least a portion of the first metal and the second metal  
12 within dielectric material.

1                    10.     The method of claim 9 wherein the first metal and the second metal  
2 are the same.

1                    11.     The method of claim 9 wherein:  
2                    patterning the first mask comprises patterning a negative photoresist mask;  
3 and  
4                    patterning the second mask comprises patterning a negative photoresist  
5 mask.

1                    12.     The method of claim 11 wherein removing the negative and positive  
2 photoresist masks defines a lead frame comprising a diepad portion and a pin portion, the  
3 method further comprising:  
4                    encapsulating the lead frame within a plastic package body; and  
5                    separating the first metal from the first layer, wherein the first exposed  
6 regions correspond to a pin portion exposed on a surface of the package body.

1                    13.     The method of claim 12 wherein the lead frame is encapsulated  
2 within a cell of a mold, such that individual packages are singulated upon separation of the  
3 first metal from the first layer.

1                    14.     The method of claim 12 further comprising:

2                   forming an etch stop layer over the first metal prior to forming the second  
3 metal;

4                   etching a portion of the first metal revealed by separation from the first  
5 layer to form a cavity; and

6                   introducing additional dielectric material within the cavity.

1                   15.     The method of claim 14 wherein forming the etch stop layer  
2 comprises electroplating a metal different from the first and second metals within the first  
3 exposed regions.

1                   16.     A lead frame for semiconductor device package, the lead frame  
2 comprising:  
3                   a diepad comprising a metal;  
4                   a pin separate from the diepad; and  
5                   an electroplated raised feature comprising the metal, formed on at least one  
6 of the diepad and the pin.

1                   17.     The lead frame of claim 16 wherein the raised feature comprises a  
2 QFN package pin portion extending to a surface of the package.

1                   18.     The lead frame of claim 17 further comprising a second raised  
2 feature comprising a portion of the diepad extending to the package surface.

1                   19.     The lead frame of claim 16 wherein the raised feature is located on  
2 an upper surface of the diepad for ensuring even spreading of adhesive and resulting  
3 uniform attitude of a die placed attached to the upper surface.

1                   20.     The lead frame of claim 16 wherein the raised feature comprises a  
2 stud on the pin for elevating a power ball grid array (BGA) package above a surface.

1                   21.     The lead frame of claim 16 wherein a perimeter of the diepad  
2 exhibits a serpentine shape.

1                   22.     The lead frame of claim 16 wherein the pin lies between the diepad  
2 and an outer pin.

1                   23.     The lead frame of claim 22 wherein the raised feature comprises an  
2 additional thickness of the outer pin, such that the outer pin is taller than the pin.

1                   24.     A method of fabricating a metal lead frame, the method comprising:  
2                   patterning a negative photoresist mask over a substrate;  
3                   electroplating raised portions of a copper lead frame within regions  
4 exposed by the negative photoresist mask;  
5                   patterning a positive photoresist mask over the negative photoresist mask  
6 and the raised copper portions;  
7                   electroplating diepad and pin portions of the copper lead frame within  
8 regions exposed by the positive photoresist mask;  
9                   removing the negative and positive photoresist masks;  
10                  attaching a die to the diepad;  
11                  encapsulating the die and lead frame within plastic; and  
12                  separating the raised copper portions and the plastic from the substrate.

1                   25.     The method of claim 24 further comprising singulating the  
2 encapsulated die and lead frame from adjacent packages by sawing.

1                   26.     The method of claim 25 wherein:  
2                   the die and lead frame are encapsulated within a cell of a surrounding mold;  
3 and  
4                   separation of the raised copper portions and the plastic from the substrate is  
5 accomplished by chemical etching, resulting in singulation of the encapsulated die and  
6 lead frame from adjacent packages.

1                   27.     A method of fabricating a lead frame for a power ball grid array  
2 (BGA) semiconductor device package, the method comprising:  
3                   providing a first metal layer including a pin portion;  
4                   patterning a mask over the first metal layer to reveal an exposed region on  
5 the pin portion;  
6                   electroplating a metal over the exposed region to form a raised pin feature;  
7 and  
8                   removing the mask.

1                    28.     The method of claim 27 further comprising:  
2                    providing a PC board bearing a solder ball; and  
3                    placing the raised pin feature into contact with a PC board, such that a body  
4 of the power BGA package is elevated above the PC board in contact with the solder ball  
5 and preserving a rounded shape of the solder ball.